National Training Resources for Firefighter MCI Response

1.0 *PROJECT PURPOSE.*

The Federation of American Scientists (FAS) is seeking support to develop a National Training Resources (NTR) Center for Firefighter Mass Casualty Incident (MCI) Response project. The project will support the creation, sharing, evaluation, and Internet deployment of a prototype single- and multi-player training game that combines realistic simulations with advanced training technologies to teach teams of firefighters. Training simulations and instructional materials developed by the project will be made available to individual fire stations and training facilities throughout the US, and would be customizable to meet local training needs. The NTR project will demonstrate use of networking deployment of new technologies to dramatically improve MCI training on a national level and serve as a model for other first responder training. The training tools will be developed with, used, and tested by the New York City Fire Department (FDNY), by the Academic Advanced Distributed Learning Co-Lab at the University of Wisconsin, Madison, and by instructors in the Wisconsin Technical College System (WTCS) Firefighter training programs, accredited by the International Fire Service Accreditation Congress.

1.1 The Problem. Training firefighters to respond to MCIs poses a special challenge; because MCIs encompass everything from terrorist attacks to environmental disasters, firefighters must be trained in a wide range of scenarios to prepare for the unexpected. Full field training exercises are powerful learning experiences, but extremely expensive. In May 2003, the US Dept. of Homeland Security Office of Domestic Preparedness and the US Dept. of State, in cooperation with federal, state, local, and Canadian partners, undertook a five-day, full-scale exercise and simulation (Top Official 2, or TOPOFF 2) to determine how the nation would respond in the event of a weapons of mass destruction (WMD) attack. TOPOFF 2 cost $16 million dollars and consisted of simulated attacks in the Chicago and Seattle metropolitan areas. The cost and complexity of these exercises limit the number that can be undertaken. This means that most emergency personnel can only be trained on a single incident in any given year. Additionally, in many large urban departments, like FDNY, training costs increase because it usually requires taking members out of the field and compensating them on an overtime pay scale.

Large urban areas, such as New York City, are especially vulnerable to MCIs involving terrorism. The threats facing New York City are well documented. A report by McKinsey & Company, which analyzed FDNY's MCI response following 9/11, urged more effective MCI response training. (A summary of the report is provided as Appendix 2.) New York City's high concentration of people and business establishments, and massive subway infrastructure, increase the likelihood of mass casualties and destruction of property in event of a terrorist act. In response, the FDNY has been aggressively developing advanced strategic responses to bioterrorism, WMDs, and other potentially catastrophic events. Although much of the MCI focus has been on large metropolitan areas, small town and rural areas, seemingly less likely targets for terrorism, still experience a variety of MCIs, e.g. toxic chemical spills resulting from train derailments and truck accidents, wind-whipped forest fires, destructive tornadoes, and life-threatening heat waves. Training firefighters in small towns and rural areas is complicated, because many departments are made up solely of volunteers who are most often first on the scene,

before professional firefighters can arrive. Training difficulties for these departments are exacerbated by their distance from fixed, live-fire training facilities.

While current programs to train for an MCI exist, they are under-funded, do not allow for the uniqueness that each situation and location will present and, in many instances, do not motivate the trainee. Nationally, this is a significant problem – as approximately 1.7 million volunteer and full-time firefighters must be trained for MCIs. Unfortunately, many report that they feel unprepared to respond to an MCI.[1]

1.2 The Solution. To affect solutions to the problems cited above, network technology, simulation tools, and information resources have the potential to reach large numbers of people quickly with timely information, provide cost-effective training for dispersed populations, allow for training tailored to unique local situations, and provide simulated experiences (including group interactions) that transfer efficiently into high levels of performance in an actual emergency. Training and updates made available online could be accessed by crews and individuals during their downtime at the fire stations. Access to easy-to-use training tools via the Internet would enhance the effectiveness and knowledge base of even the most geographically distant volunteers. Engaging simulation gaming could be used to supplement professional firefighting curricula at technical colleges and training institutes.

Our project will build on the preliminary work undertaken by programs such as the Metropolitan Medical Response System (MMRS), administrated by the US Department of Health and Human Services (HHS), and will address the shortcomings of prior programs through the development of innovative, engaging educational tools. The project addresses needs identified in the FDNY McKinsey report: improve upon the FDNY system which updates and disseminates information; provide more HAZMAT and WMD training and capabilities and more scenario-based training; and more effective coordination of the FDNY's emergency response plans. Working with the FDNY, we will develop a prototype of a single- and multi-player training game that combines realistic simulations for teaching teams of firefighters to work together efficiently in a variety of MCI scenarios and develop and execute effective management plans for response. (Other training tools may be added later in the project, as discussed in the Sustainability section.)

The prototype training system will enable PC desktop simulated disaster drills to train personnel and test fire departments' MCI response plans. A design objective is to keep the training simulations fast-paced and rewarding. This will challenge the trainee with ever-more difficult levels, under varying scenarios, while maintaining the accuracy of the training content. Individual fire departments will be able to modify training scenarios to meet their training requirements and to include local fire stations, train stations, schools, churches, restaurants, shopping malls, etc. Multiple incidents, including man-made and natural disasters adjusted by town size, will be supported. The latest information on MCIs will be available for download from the NTR website and other linked sites.

This project also tests replicability. WTCS will take the training game tools developed for the FDNY, make any necessary adaptations for Wisconsin firefighting, and run preliminary assessments on the tools to determine whether they can be submitted for certification to national MCI standards. The visualization objects and learning content resulting from this project will be cataloged into a database on the NTR project website

and made available to FDNY and WTCS instructors seeking to build customized training scenarios. In addition, the resulting training simulations and instructional materials will be available to individual fire stations and training facilities via the Internet, enabling large numbers of firefighters to access the materials. The Internet will be used to provide online help to instructors and experts wherever firefighters are training.

1.3 Measurable Outcomes. Our goals for the project are: (a) to integrate MCI responder training into a system that is decentralized and designed to be updated quickly; (b) to deliver complex information to a diverse, geographically dispersed audience in a short period of time when the information itself is changing; (c) to provide practical, hands-on experience in situations that cannot easily be practiced using real scenarios; and (d) to ensure the essential skills are retained once learnt by an individual, team and/or organization. Our detailed activities (project outcomes), along with how we intend to evaluate our success in meeting them, are listed in Appendix 4: *Project Schedule and Evaluation.* Obviously, a long-term outcome is that firefighters' preparedness to respond to MCIs will increase as they are presented with the most up-to-date information and training. Well-trained firefighters can assure a quick response time and effective handling of these situations to limit casualties. The firefighters can also safeguard their own lives if they are more knowledgeable about different scenarios that could occur and the appropriate response to each.

2.0 *INNOVATION*

While Internet and CD-based training materials provide an efficient way to deliver training material, this is only a small fraction of the potential offered by new technologies. Training opportunities may be enriched through application of advanced instructional technologies, including simulations and intelligent tutoring systems. Advances in systems integration allow for new training opportunities to reach learners through two versatile approaches: embedded training and distributed training.

Decades of cognitive science research have shown that people perform better after instruction when they have learned information in the context of doing.[2] They develop a deeper, fuller understanding of the knowledge presented,[3] they retain information better, and can adapt acquired information better when it is learned through the process of solving complex problems in realistic situations.[4] Perhaps most importantly, learning by doing improves the chances that learners will actually call upon this information when they are confronted with new problems.[5] The problem is that "learning by doing" is often much too expensive, and dangerous, to be practical for most MCI training needs.

Live-action game and simulation activities and problem-based learning modules have proven benefits in training.[6] Problem-solving instructional methods can compress years of on-the-job experience and reduce training times by as much as 80 percent. These methods are also highly motivating as participants immediately recognize the importance of the training they are receiving. Advances in computational technology – particularly inexpensive graphics capabilities – now make it feasible to deliver high quality simulations on typical desktop personal computers. New communication systems can ensure efficient delivery of up-to-date information and allow the construction of systems to link large numbers of learners and instructors within the same system (e.g., a popular online computer game Everquest often has more than 100,000 players at any given time). Computer games hold special interest to the current generation who has grown up with

them. Before age 21, the average person born today will have spent 10,000 hours playing video games.[7]

3.0 *COMMUNITY INVOLVEMENT*

3.1 Partnerships. This project brings together a team with complementary expertise in learning research, distributive learning tool development, gaming, technology, and firefighter training. Detailed organizational descriptions are included in Appendix 3, *Project Partners and Key Personnel Bios*. The partners are:

Federation of American Scientists (FAS) will serve as the project's fiscal agent and overall project coordinator. FAS is a non-profit research institution with a sixty year history of providing science and technology analysis. This project will leverage three years of work by FAS toward developing a national R & D plan in learning science and technology and analyzing the potential for advanced training technologies to improve MCI response.

The New York City Fire Department (FDNY), the largest in the country, serves as a model to other professional firefighters the US, holding an impressive reputation. The FDNY will identify the scenarios and objectives for the training game and assist with development and evaluation of the training scenarios. However, keeping a uniformed force of more than 11,000 firefighters and 2,800 Emergency Medical Technicians and Paramedics current with up-to-date specialized information is a considerable challenge. In the case of volunteers, time conflicts with primary jobs also hamper access to training.

The Academic Advanced Distributed Learning (AADL) **Co-Lab**, in Madison, Wisconsin, focuses on increasing access to the high quality distributed education and training tailored to individual needs with cost-effective delivery.

The Wisconsin Technical College System (WTCS) is the designated fire service education and training delivery mechanism for the more than 870 fire departments in Wisconsin. The WTCS programs include 87 accredited courses and an Environmental Haz-Mat Specialist Program.

3.2 Support for End Users. The project will have two groups of end users: the training instructors and the firefighters. Training instructors working in the training facilities of the fire departments will need to know how to: operate the program; customize the program for their area; upload new information; use the program as a teaching tool; guide effective use of the program; and analyze the performance data. FDNY training instructors have limited experience using technology-based training materials and systems, thus our project plans include training for those instructors. The AADL Co-Lab staff has significant technical expertise and experience instructing novice users of computers. They will work closely with the FDNY instructors to train them on the use of the system and to assist with any technical problems. We plan to train twenty instructors in two 2-day training classes to be held at the FDNY training facilities. Instructional materials will be provided with the program; the Internet will link FDNY instructors to the FAS and SimQuest Games staff for technical support for the training system.

For the second group of users, the firefighters, our goal is develop the training system such that it requires minimal instruction to learn to use – it should be as intuitive as a typical video game. The game will include embedded instructions and help tools. FDNY trainees will be invited to "play" the game prior to formal classroom instruction in which FDNY instructors will explain how to use the training system. The game will

include question asking and answering capabilities and connections to real experts, in addition to a "Frequently Asked Questions" database.

Fire training instructors at WTCS will not extensively deploy the scenarios, but will review the FDNY scenarios, and identify additional ones to be created by the AADL Co-Lab, then pilot and evaluate their use and make suggestions as to their appropriateness for use in national certified training.

3.3 Stakeholder Involvement. The project directly involves two key stakeholders – the FDNY, our nation's premier firefighting department, and the WTCS, which has nationally accredited firefighter training programs on 16 of its campuses – as partners. In the post 9/11 environment, the FDNY has embarked on a plan to build upon members' core competencies and deploy new specialized resources. The strategy is to build-up a tiered, multi-function response capability that will result in both increased everyday productivity and a more robust capacity for response to terrorism. FDNY believes that technology-based training programs will enable it to achieve its goal of providing access to the most up-to-date specialized information and eventually transforming the learning process into an ongoing, career spanning pursuit. It has made a strong commitment to this project, both in terms of funds provided by NYC to purchase computers for training, and in terms of its plan to train over 2,000 firefighters and approximately 20 instructors to use the project's technology tools. The WTCS currently utilizes a combination of conventional teaching methods and distance education technology in its Fire Protection Technician program, and has a strong interest in tools and methods to extend the use of technology to improve its training programs. Letters of commitment from the stakeholders are included in Appendix 3, *Project Partners and Key Personnel Bios.*

4.0 *EVALUATION*

An outside evaluator will be hired to lead the evaluation activities. An evaluation committee will consist of a representative from each partner institution, and the project director who will work with the outside evaluator. Approximately 10 percent of the project budget is allocated for evaluation. Appendix 4, *Project Schedule and Evaluation* describes the project timeline, responsible individuals, and evaluation measures for each major activity of the project.

4.1 Strategy A *formative evaluation* will examine what happens as the partnership team implements the project and a *summative evaluation* will examine the project's outcomes. The *formative evaluation* will be used to implement and document the training system, materials, delivery, access, and response. It will describe and monitor the project's development and deployment of the training resources; identify any problems as they occur so that they may be resolved; and document whether the project goals were met. This evaluation will provide a means to replicate the model. The *summative evaluation* will examine the outcomes of the project. It will assess the instructors' satisfaction with the training system, learning materials, and tools that support it; whether there were gains in learning; and user satisfaction, including comfort with the technology, and level of engagement with the training system. The evaluation will describe the firefighting departments' assessment of the training tools and access to the supporting training materials. It will assess the ease with which the training tools developed for FDNY use

were adapted for use by the WTSC. The *summative evaluation* will also examine how the partnership model can be replicated or adapted for other communities or other MCI response.

4.2 Questions. The evaluation will answer four main questions: (a) can the NTR training content be updated and adapted quickly; (b) is the form of technology used by the project appropriate (i.e., can it deliver complex updated information to a diverse, geographically dispersed audience rapidly); (c) is there a measurable increase in performance among the trainees who use the training game; and (d) are essential skills sustained once attained by the individual, team and/or organization?

4.3 Data Collection and Analysis Plan. The evaluation process will continue throughout the grant period. *Formative* data will be collected from the project teams as part of regular discussions and requested reports. The Project Director will be responsible for collecting the data and making it available for the independent evaluator. *Summative* data will be collected during the six months of the pilot program. The evaluation committee will track participation in the program by individual, fire department, geographic location, time and date accessed, time spent, and assessment results. FDNY will provide baseline data that will be used to determine if use of the training game improves performance. Surveys and focus group interviews targeted at the trainees and MCI response instructors will also be used. Analysis of the data will be performed by the independent evaluator.

4.4 Final Evaluation Report. The final evaluation report will be written by the independent evaluator. It will be published online and made available on the project website during and for at least two years following the grant-period.

5.0 PROJECT FEASIBILTY

5.1 Technical Approach. The project's major or multi-purpose tasks are described below. Additional detail is provided in Appendix 4, *Project Schedule and Evaluation*. Five MCI training scenarios, selected by the FDNY, will be developed. Training objectives and learning content, including visualization objects specific to NYC, will be developed for each scenario. A simulation-based training game will be developed that will integrate the training objectives and learning content for these scenarios. FDNY will use the training game as part of the formal training conducted at its Randall's Island Training Facility. In addition, firefighters will be given a CD-Rom of the game for use anywhere, and will also be available for download from the NTR project website over the Internet.

The WTCS will review the training game scenarios developed for the FDNY and provide feedback regarding how well they meet certification requirements. WTCS will identify visualization objects (buildings, city streets, etc.) specific to Wisconsin that can be incorporated into the training game and the AADL Co-Lab will be tasked with designing them and embedding relevant learning objectives. A database will be maintained and developed on the NTR project website for the WTCS and FDNY instructors to build customized training scenarios. The instructional game will be designed for a personal computer and will not require upgraded video graphics cards or

high-speed network connections. The prototype instructional game will use an existing gaming engine and standard visualization software, such as Studio Max 3D, to minimize development costs and increase the replication of the methods employed.

The training game will include Q&A capability and instant messaging to provide links to real instructors. A detailed Frequently Asked Questions (FAQ) archival system will track inquiries, identify areas of weakness for specific trainees, and recommend online training materials for review. After completing a case scenario, the trainee will have access to automated debriefing, including bulleted statements regarding correct and incorrect choices, and a text-based report that can be shared with instructors. A Learning Management System (LMS) will include event recorders and a common administration database containing student performance ratings. When connected to the Internet, data on game play can be uploaded to the NTR project website and be used to update the FAQ database, update the trainee's performance record (selectable by the trainee), and record usage information for project evaluation. In multi-player mode, the game will require connection to the Internet. Trainees will be able to interact using text- and instant-messaging over the Internet to work cooperatively to accomplish mission goals and to work with instructors to gain expert advice.

Learning content and materials will be stored on the NTR project web server and cataloged in a keyword searchable database. Technical infrastructure: The NTR project web server will run on standard HTTP/1.1 protocol. Anyone with a phone modem connection and a web browser to the Internet can access the web-based resources. The applications will use freely available technologies such as JavaScript supported web browsers (e.g., Internet Explorer, Netscape Navigator) and Real Player, which come preinstalled on most modern personal computers, so different operating systems (e.g., Windows, Mac OS, UNIX, Linux) will be able to access the NTR. The AADL Co-Lab's expertise in the creation of the Sharable Content Object Reference Model (SCORM) standards will enable developers to produce content that is sharable, reusable, and, most importantly, interoperable. We will use Standard Query Language (SQL), widely supported in most Relational Database Management Systems, for the knowledge management database. End-users will be able to use simple keywords to search the training materials database without any need for specialized training. The text-based training materials (PDF documents) and visualization objects (buildings, landmarks, etc.) will be stored on the NTR project server. The system is scaleable to encompass a large growth of users, training, and course modules and visualization objects. If needed, distributed databases can be linked to expand storage capabilities.

5.2 Applicant Qualifications. The proposed project is fortunate to draw upon extensive, proven expertise of all its partners in the areas of technology, learning, and/or firefighting expertise and in management of, as well as participation in multi-partner projects. Appendix 3, *Project Partners and Key Personnel Bios*, describes the qualification of the applicant and partners.

5.4 Privacy and Security. The AADL Co-Lab, which will host the server for the duration of the proposed project, already incorporates restricted file system access, database security restrictions, antivirus software, and patched systems, and within the next few months will also have a new firewall provided by the University of Wisconsin

System Administration. If needed, the AADL Co-Lab can also offer a stand-alone server, off of our standard network, with secure HTTP access and a secondary software firewall. The use of specific individual and fire department identification numbers will be used to limit access. Our goal is to institute the necessary security measures to provide the highest level of site safety and user privacy that is feasible. Staff education and usage guidelines related to security and are currently in place.

5.5 Sustainability. One of the major design features of the proposed system is low operational expense. The new FDNY computer systems and software should have a useful life of three years. Knowledge management software and support programs will be designed and standardized for ADL-compliance so that they can be updated with minimal effort. Prior FDNY experience has shown that training materials need to be updated every 2-3 years. We feel confident that the project will successfully demonstrate the future of MCI response training, and we will seek funding and matches from state and local resources, foundations, and corporations for the continuation and expansion of the project. If we are not successful in obtaining additional funding, FAS has agreed to host and maintain the NTR web-server for two years beyond the life of the project grant.

5.6 Dissemination. Analysis of the project will be documented through a written report and published online through the FAS site, via a linkage on the AADL Co-Lab site, and on firefighter community information portals, such as the one hosted by the Wisconsin Fire Chiefs Assn. During the grant-period and for at least two years thereafter, a blog will be hosted on the NTR web-server to give firefighters an opportunity to contribute their reactions to NTR products. Team members, representing diverse professions, will present papers at regional and national conferences on topics ranging from learning technologies to firefighter training and will actively pursue opportunities to publish project-related papers in both electronic and hard copy professional and organizational publications. The NTR project is seen as determining a prototype for simulation training games that can be replicated for firefighter training in other cities and states. Further, it is anticipated that these role-based and massive-multiplayer gaming environments can be expanded to design and test game-based modules for professional training in other fields that could benefit from social interactivity, context sensitivity and connectivity.

PROJECT BUDGET. The project budget is described in the Budget Narrative.

References are located in Appendix 1.